

PSYCHE.

ARE THE MALLOPHAGA DEGENERATE PSOCIDS?

BY VERNON L. KELLOGG, STANFORD UNIVERSITY, CALIF.

In a paper published in 1896* I effectively concealed some remarks which I hoped might revive interest in a question that of late years has been allowed to drop into an undeserved innocuous desuetude. This question or problem concerns the phyletic relations of those insects which have been shuffled about by systematic entomologists more perhaps than any other insects, those namely that began as a great host forming the order Pseudo-Neuroptera, were later divided into smaller hosts ordinarily classified as Pseudo-Neuroptera, Platyptera and Corrodentia, and which now are wholly freed from genealogical entanglements with each other by appearing in the textbooks as a series of small orders, each present order corresponding to the families of the earlier catch-all orders. That my remarks had no attention was their deserved fate; deserved for allowing themselves to get into a too corpulent "new species" paper. Such papers are properly filed for reference, not read, and so my intention of giving the Psocidae

the ill name of being the ancestors or the very immediate relatives of the ancestors of the biting bird lice (Mallophaga) got itself simply filed for reference.

But I did mean to ask seriously the question whether or not the Psocids and the Mallophaga are not more nearly related than their present classification would lead one to suspect; whether indeed they should not properly compose a single order readily separable into two sub-orders, but obviously linked by a common descent. And in the last five years I have, with the handling of many more Mallophaga, and the occasional re-examination of the Psocid body, had my notions only made more distinct, and my inclination to answer the question in favor of the common origin of the two groups only strengthened. And the reasons for this believing are outlined in the following paragraphs.

While recognizing clearly the occurrence among unrelated forms of "parallelism of development" and "parallelism of structure" there is yet a certain degree of similarity approaching identity, which, when reached, we can explain only on the basis of community of origin, and descent. This degree of approxi-

* New Mallophaga II, from land birds, together with an account of the Mallophagous mouthparts. Contrib. to Biol. from Hopkins Seaside Laboratory of Leland Stanford, Jr. University, No. VII, 117 pp. 14 plates, November, 1896.

mate identity is, of course, not determinable by arbitrary convention, nor, in the present state of zoological science, by quantitative measure, but its recognition is in most cases obvious to all naturalists, and the power to recognize parallelism when existing, and to recognize identity due to common origin and descent when existing is simply one of the required qualifications of the competent systematic zoologists. In my belief the Mallophaga and Psocidae possess in common certain peculiar and characteristic structural features (coupled with corresponding physiological features) whose practical identity must be ascribed to community of origin and which thus reveal a community of descent on the part of the insects themselves.

In my paper *New Mallophaga II* previously referred to, are described and illustrated in detail the mouthparts of four Mallophagous genera (pp. 431-457 plates LX-LXII). Three of these genera thus described, and ten other genera examined, although not described in detail, are found to possess a well-developed peculiar pharyngeal or oesophageal sclerite characteristically constant in position and shape, and of important use in the manipulation of the dry food (bitten off parts of feathers) of the insects. (In four of these genera there appear to be species lacking the sclerite — or, at least, having it in such weakly chitinized condition as to make it invisible when the undissected head of the specimen is examined.) In five Mallophagous genera this sclerite is ab-

sent. In the four remaining known genera of the order no specimens are at hand. This peculiar sclerite is a thickening of the chitinous intima of the pharynx, and appears as a bonnet-shaped sclerite lying on the ventral wall of the pharynx, with hollow part upward, with median groove closed behind, projecting processes at the interior angles, and a pair of long slender "bonnet string" pieces, which project dorsally and pass on either side of the pharynx, or oesophagus, upward and around it, and attach by their ends to the dorsal wall of the head. Opening into the median groove from its ventral side is a small duct, which, followed to its source, is seen to come from the union of a pair of ducts, each one of which comes from an oval gland lying ventral to the sclerite, and fitting into a concavity on the anterior end of a weakly chitinized, pedicel-like structure, which projects backward and is attached by a foot-shaped expansion to a large, strong muscle. (Figures of this oesophageal sclerite and glands are given on plate LXII in *New Mallophaga, II.*)

Apart from this peculiar addition to the usual biting insect mouth, two of the four genera of Mallophaga whose mouthparts were carefully studied were found to possess certain peculiar "forks" in the mouth, which by dissection are seen to be very small chitinous rods lying inside of the mouth above the labium whose posterior ends attach to the ventral wall of the head by muscles, and whose anterior ends are strongly forked or

bifurcated and project through the ventral wall of the mouth thus lying free and uncovered in the mouth cavity. Although not observed in the other two genera of Mallophaga dissected, it is not at all certain that they are not present, their extreme minuteness and delicacy making their discovery a matter of difficulty. (Figures of these "forks" are given on plate LX, *New Mallophaga*, II.)

For the rest, the Mallophagous mouth is of simple biting type with a considerable reduction of the maxillae, the maxillary palpi being wholly wanting.

Thanks to Edward Burgess the anatomy of the mouth of the Psocidae has been known since 1878.* The unusual features, long familiar to entomologists as curious and unique structures, of the Psocid mouthparts are the so-called "forks" of the mouth and the so-called "oesophageal bone" and paired "lingual glands" of the pharynx. Burgess's description of one of the Psocid forks is as follows. "This is a slender, more or less curved chitinous rod with a forked bifid tip, and two or three times as long as the outer lobe. The distal portion of the fork, about one-third or less of its length, projects through the lining membrane of the mouth. At this point the fork is stoutest, and from it, it tapers to either end, the outer portion being stouter than the inner. The membrane where it is united with the fork is deli-

cate and elastic, thus permitting the fork to be projected forward or drawn back at will. Within the head the fork is held in position by muscles inserted on its base, which unite it with the lobe and stripes of the maxilla, and by a ligament which runs backward to the top of the head." (Figures of the "forks" are given in Burgess's paper, and copied in plate LXIV of *New Mallophaga*, II.)

I have simply to add that the Psocid "forks" are in structure, position and attachments practically identical with the Mallophagous "forks," and whether Burgess's view that the forks are new and independent mouthparts, or Scudder's view that they are the modified maxillary laciniae, be true, the Mallophagous forks can readily be homologized with them, for the Mallophagous maxillae have but one terminal lobe and would be not at all sorry to find in the forks their lost laciniae!

Burgess's description of the "oesophageal bone" of the Psocidae is as follows: "Below the opening of the oesophagus lies a bone which may be fancifully likened to a lady's bonnet upside down; the high front lies along the oral cavity at about half way up; two narrow extensions, representing the bonnet strings, run forward and upward, embracing the oesophagus. The great bundles of short muscles filling the large vaulted clypeus are attached to the ends of these strings, and by their contraction close the oesophagus. Just below the front a fine duct opens which is the common duct of a pair of lingual glands.

*The anatomy of the head and the structure of the maxillae in the Psocidae. Proc. Bost. Soc. Nat. Hist., 1878, Vol. XIX, p. 291, pl. VIII.

These can be seen through the semi-transparent mentum and labium, offering an irregular, obovate outline. A short duct from the lower end of each gland leads into a common duct which opens in the oesophageal bone as already described. The ducts curve over the lower end of the glands and run up their posterior surface, to which they are soldered nearly to the top. The line of the ducts together with the lateral outlines, give the glands a three-cornered shape, somewhat like that of a butternut. A little triangular cup fits on the summit of each gland, and on it is inserted a suspensory muscle, the upper end of which is attached to the cranium." (Figures of "bone" and ducts are given in Burgess's paper and copied in plate LXIV of *New Mallophaga II.*)

I have again simply to add that the "oesophageal bone" and its accessory "lingual glands" of the Psocidae, are surely the "oesophageal sclerite" and its accessory glands of the Mallophaga.

The important thing about this correspondence between "forks" and oesophageal structures in the two groups is that the same structures do not occur elsewhere among insects.

Perhaps the most familiar Psocid form is the degenerate genus *Atropos*. It is very different from the winged forms; in fact it is the "link" that connects the winged Psocidae with the Mallophaga. In *Atropos* as in the Mallophaga there are no traces of wings; the whole body, head, thorax, and abdomen is flattened exactly as in the Mallophaga; the meso-

thoracic and meta-thoracic segments are fused to form a single segment, one of the characteristic structural conditions of the Mallophaga, while the great development of the clypeus and the restriction of the mouthparts to the ventral aspect of the head, so characteristic of the bird-lice, is quite as characteristic of this degraded Psocid. So too the peculiar condition of the labrum in the Mallophaga lying as it does on the ventral aspect of the produced clypeus finds an identical repetition in *Atropos*. The mandibles of *Atropos* present a really striking similarity with those of the Amblycerous group of the Mallophaga, the details of teeth, condyles, facets and musculation being extraordinary alike.

The internal anatomy of the Psocids has yet to be worked out in detail, although Nitzsch, in 1821, described the alimentary canal and the reproductive organs of *Clothilla pulsatoria* (a degraded wingless form much like *Atropos*). He found the alimentary canal to be very simple, without special crop or proventriculus, and with a simple elongate stomach consisting of a sac-like anterior part and a longer tubular posterior part. There are four Malpighian tubules. The intestine is very short, its rectal portion being as long as all the rest of it. The ovaries consist of five egg-tubes on each side; connected with the oviduct there is a peculiar accessory gland consisting of a sac containing other small sacs each with an elongate efferent duct, the number of these secondary sacs varying from one to four

according to the individual. The testis is a simple capsule; connected with the base of the jaculatory duct there is a pair of elongate accessory glands or vesiculæ seminales.

The internal anatomy of the Mallophaga has been described by Grosse (for the species "*Tetrophthalmus chilensis*" = *Menopon titan*), by Nusbaum, and latest and in most detail by Snodgrass,* who studied comparatively the various organs in several species. With reference to the alimentary canal, Malpighian tubules and reproductive organs (the only organs which have been described for the Psocidae and can therefore be compared, with the similar Mallophagous organs), Snodgrass finds that the alimentary canal in the Mallophaga presents two types, one being "simple, having no special development at any part" and possessed by the Amblycera, (one of the two sub-orders into which I have divided the Mallophaga) the other "complicated by a lateral and backward prolongation of the crop so that the latter forms a large expanded diverticulum of the oesophagus." This second type is possessed by all the members of the sub-order Ischnocera. In the simple type the canal corresponds thoroughly well with that of Clothilla, even to the shortness of the intestine as compared with the rectum. With regard to the Malpighian tubules Snodgrass finds their number constant throughout the Mallophaga. That number is four, as in

Clothilla. Finally comparing the reproductive organs Snodgrass finds the number of egg tubes to be five in the sub-order Ischnocera and to vary from three to five in the Amblycera. In Clothilla there are five. In the Mallophaga the testes are either two or three in number on a side and there is a pair of semina-vesicles, with its two members either distinct or more or less fused. In Clothilla there is one testis on a side, and a pair of seminal vesicles.

So far as the comparison can be made then it is obvious that a great similarity in character of internal organs exists in the degraded wingless Psocid Clothilla, and the Mallophaga.

Finally it is interesting to note the similar habits of *Atropos*, *Clothilla* and the other dust-lice or book-lice (including all the degenerate wingless Psocids) and the biting bird lice or Mallophaga. These book-lice feed on dry dead organic matter, such as wood and paper, dried insects and dried bird and mammal skins; the Mallophaga feed exclusively on the dry dead dermal scales, hairs and feathers of mammals and birds. I have found *Atropos* often in the nests of birds; was it feeding on the feathers there? What a simple step from the feathers off the bird to the feathers on the bird! Then *Atropos* would be a bird-lice and a new and rather aberrant genus of Mallophaga! As a matter of fact in collections of Mallophaga sent in to me, all the specimens presumably collected from the bodies of birds, I have in a few, (very few, truly,) instances received specimens of *Atropos*.

* Snodgrass, R. E., The Anatomy of the Mallophaga, in New Mallophaga III, Contrib. to Biol. from the Hopkins Seaside Laboratory of Leland Stanford Jr. University, no. XIX, pp. 224, plates 17 plates.